

Emerging viruses and the significance of climate change

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During the past 30 years, we have witnessed the appearance of a striking number of novel epidemic human pathogenic RNA viruses and the re-emergence of some known viruses as major inducers of human epidemics. Although human immunodeficiency virus (HIV) has proved to be perhaps the most devastating in terms of the number of fatal infections, many of the other emerging viruses are, nonetheless, responsible for high rates of morbidity and mortality. A wide range of factors can be evoked to explain why these agents of disease are appearing or re-emerging, the most obvious being increased population density (i.e. of humans, other animals, plants, arthropods), increased transportation of animals, plants and other commercial goods by ship, increased human movement, deforestation and afforestation, urbanization, irrigation projects, and increased numbers and re-location of refugees in developing countries. Additionally, during recent decades, climate change has revealed itself as a new and potentially major influence on disease emergence. Although the discovery of the hole in the ozone layer raised the alarm, a large degree of scepticism was apparent among the scientific community when the profile of climate change as a concept was first raised. Nevertheless, with time and accumulating evidence, it is now generally accepted that climate change is not only here to stay, but also that the implications for humanity could be disastrous if major remedial changes do not take place immediately.

From the point of view of virus diseases, some quite obvious likely impacts of climate change were relatively easy to predict; for example, arthropod survival is wholly dependent on appropriate ecological conditions. Thus, alterations in

average temperature, humidity and vegetation quality, as well as large-scale movement of animals, will inevitably be accompanied by changing patterns of arthropod distribution and the virus diseases transmitted by these arthropods. In 2005/2006, bluetongue virus (serotype 8) was introduced into northwestern Europe for the first time on record and then crossed the English Channel to the UK. Rodent population density and distribution are highly sensitive to changes in climate patterns and human distribution; rodents are also very successful travellers of the oceans. Several rodent-associated flaviviruses that are endemic to North America are genetically very close relatives of African flaviviruses. They almost certainly arrived in the Americas on cargo or slave ships via infected rodents. In this issue of *Clinical Microbiology and Infection*, we have selected four groups of RNA viruses that have not been at the forefront of our thoughts in the context of the impact of climate change on their distribution. Nevertheless, they are all highly significant human pathogens (e.g. arenaviruses, bunyaviruses, hantaviruses and noroviruses) and have all shown evidence of emergence in the recent past. The four experts on these viruses were requested to address the likely impact of climate change as the major subject, rather than to review in detail all the factors that can influence virus emergence. These were difficult assignments but the results are informative, fascinating, and provide many new ideas that should be addressed not just by academic scientists and pharmaceutical companies, but also by health agencies, whose responsibility it is to be prepared, with appropriate guidance and measures to be taken, as pathogenic viruses continue to emerge.